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Title: Capillary Condensation Transitions and Meniscus: Parallel Planes, Nanotubes, and Wedge

Herein, we investigate the behavior of vapor in confined media as it condenses into a liquid. Capillary condensation is studied in the presence of van der Waals forces. Three phases may occur in such a system: empty (no wetting occurs), film (a thin film of liquid forms), and full. We derived the grand free potential for the three phases, and the potential differences that occur in various substrate configurations. These potentials are used to explore the phase transitions, to find the triple point of a phase diagram and to show the possible coexistence between phases. By working with the potentials for film and empty phase and considering the symmetry and the boundary conditions in a gravitational free system, we obtain the shape of the meniscus of the liquid film between the two parallel plates. Other substrate shapes such as cylinders are also discussed and the meniscus is derived. We also present the wetting for the wedge. The wedge system behaves differently than planar or cylindrical systems. We discuss these differences and we present the shapes of the meniscus formed by filling for a few different substrate – liquid systems. We also discuss the phase transition between the empty and filled phase, which gives the evolution of the system. Understanding this phenomenon is especially important to the success of developing new nanoscale technologies, as surface effects become then more prevalent.